DRAINAGE REPORT

FOR

TPM 21008

March 18, 2009

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TABLE OF CONTENTS

Introduction.....1

Hydrologic Analyses.....2

Hydraulic Analyses.....2

Conclusion.....3

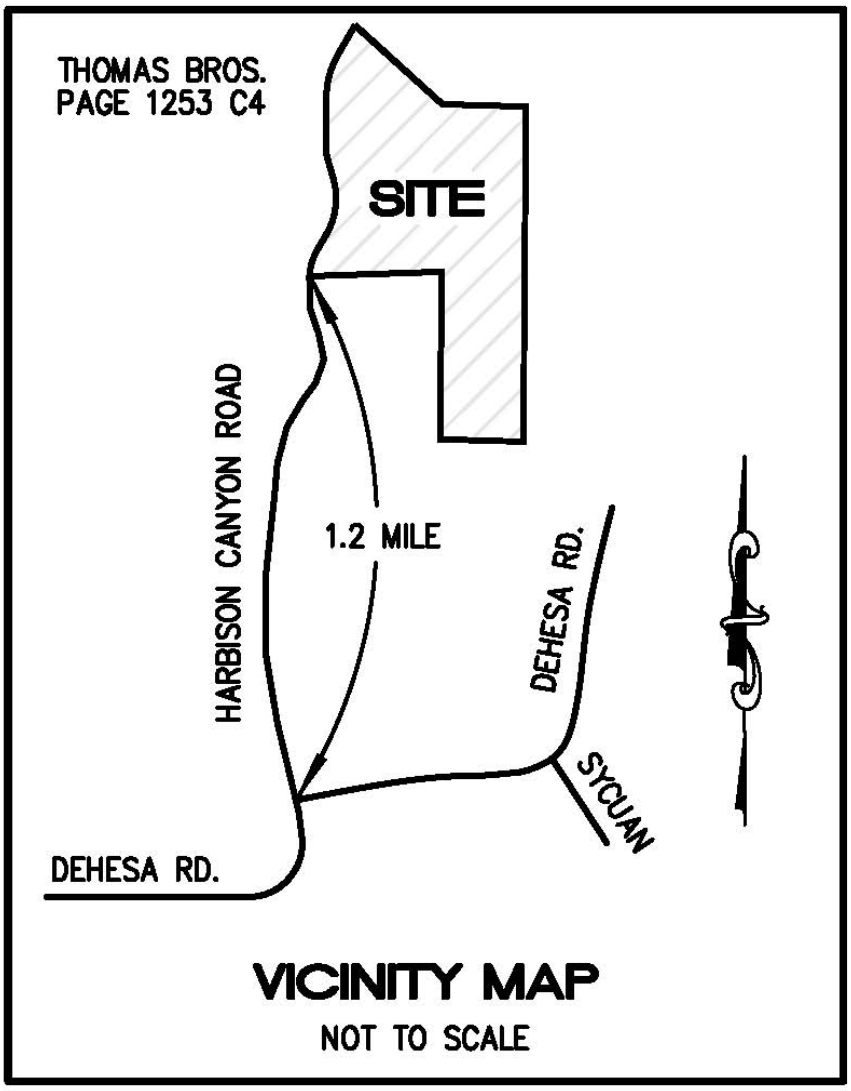
APPENDICES

A. 100-Year Hydrologic Analyses

B. Hydraulic Analyses

INTRODUCTION

Tentative Parcel Map 21008 is located east of Harbison Canyon Road just over 1 mile north of Dehesa Road. The project proposes to divide the three existing parcels (72.25 acres total) into four parcels and a remainder parcel. A single, private access road will be constructed to serve each parcel. TPM 21008 proposes grading for the access road, private driveways, and rural residential lots. The majority of the overall site will be left in its natural condition. Harbison Canyon Creek flows in a southerly direction along the westerly portion of the site. The proposed access road will cross over Harbison Canyon Creek, and surface runoff from the site flows into the creek. This report contains existing and proposed condition drainage analyses based on the TPM 21008 grading. The analyses in this report have been performed for entitlement purposes only.



HYDROLOGIC ANALYSES

Hydrologic analyses were performed for the existing and proposed conditions. The County of San Diego's 2003 *Hydrology Manual* rational method procedure was used for the 100-year hydrologic analyses. The rational method input parameters are summarized below and the supporting data is included in Appendix A:

- Precipitation: The 100-year, 6- and 24-hour precipitation values are 2.9 and 6.2 inches, respectively.

- Drainage area: The drainage basins were delineated from the base topography for the project and the proposed TPM 21008 grading. The Rational Method Work Maps in Appendix A contain the basin boundaries, rational method node numbers, and basin areas. The overall existing condition drainage basin boundary was set equal to the overall proposed condition boundary to allow a comparison of results.

- Hydrologic soil groups: The hydrologic soil groups were determined from the Natural Resources Conservation Service's Web Soil Survey. The soil group in the study area is entirely type B.

- Runoff coefficients: The undisturbed area runoff coefficients were based on the undisturbed natural terrain category, and the proposed development area runoff coefficients were based on the low density residential (1.0 DU/A or less) category.

- Flow lengths and elevations: The flow lengths and elevations were obtained from the topographic mapping and TPM grading.

The rational method analyses were performed using the CivilDesign Rational Method Hydrology Program, which is based on the County of San Diego's 2003 *Hydrology Manual*. The existing and proposed condition output is included in Appendix A. The total existing and proposed condition 100-year flow rates from the area tributary to the development are 16.4 and 18.8 cubic feet per second, respectively. Therefore, the development increases the runoff by 2.4 cfs. The 100-year flow rate in Harbison Canyon Creek is 3,900 cfs, so the additional flow represents less than a 0.06 percent increase to the creek.

HYDRAULIC ANALYSIS

The 100-year floodplain and floodway for Harbison Canyon Creek have been mapped by the County of San Diego. A portion of the County's floodplain map covering the site is included in Appendix B. The HEC-2 output for this portion is also included in Appendix B. The output contains results for the 10-year floodplain, 100-year floodplain, and 100-year floodway. The proposed access road over the creek will be located approximately between cross-sections 4.227 and 4.239, and will be an Arizona crossing with culverts designed to convey the 10-year flow rate of 850 cfs.

A CulvertMaster analysis was performed to estimate the culverts needed to convey the 10-year flow under the crossing. The minimum channel bed elevations from cross-sections 4.227 and 4.239 were used as the culvert inverts and the distance between the cross-sections was chosen for the culvert length. The downstream tailwater elevation was obtained from the 10-year water surface elevation at cross-section 4.227. The CulvertMaster input and results are included in Appendix B and show that five 48-inch reinforced concrete pipes can convey the 10-year flow with 8.5 feet of headwater.

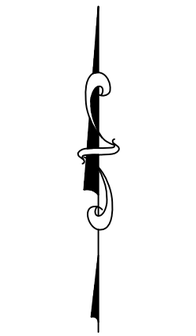
CONCLUSION

Drainage analyses have been performed for TPM 21008. The analyses in this report show that the project will have a minor impact on flow in the receiving watercourse, Harbison Canyon Creek. The analyses also provide preliminary information on the culverts needed to convey the 10-year creek runoff under the proposed access road. The analyses are at a tentative map level of detail. Additional analyses will be required for final engineering.

.

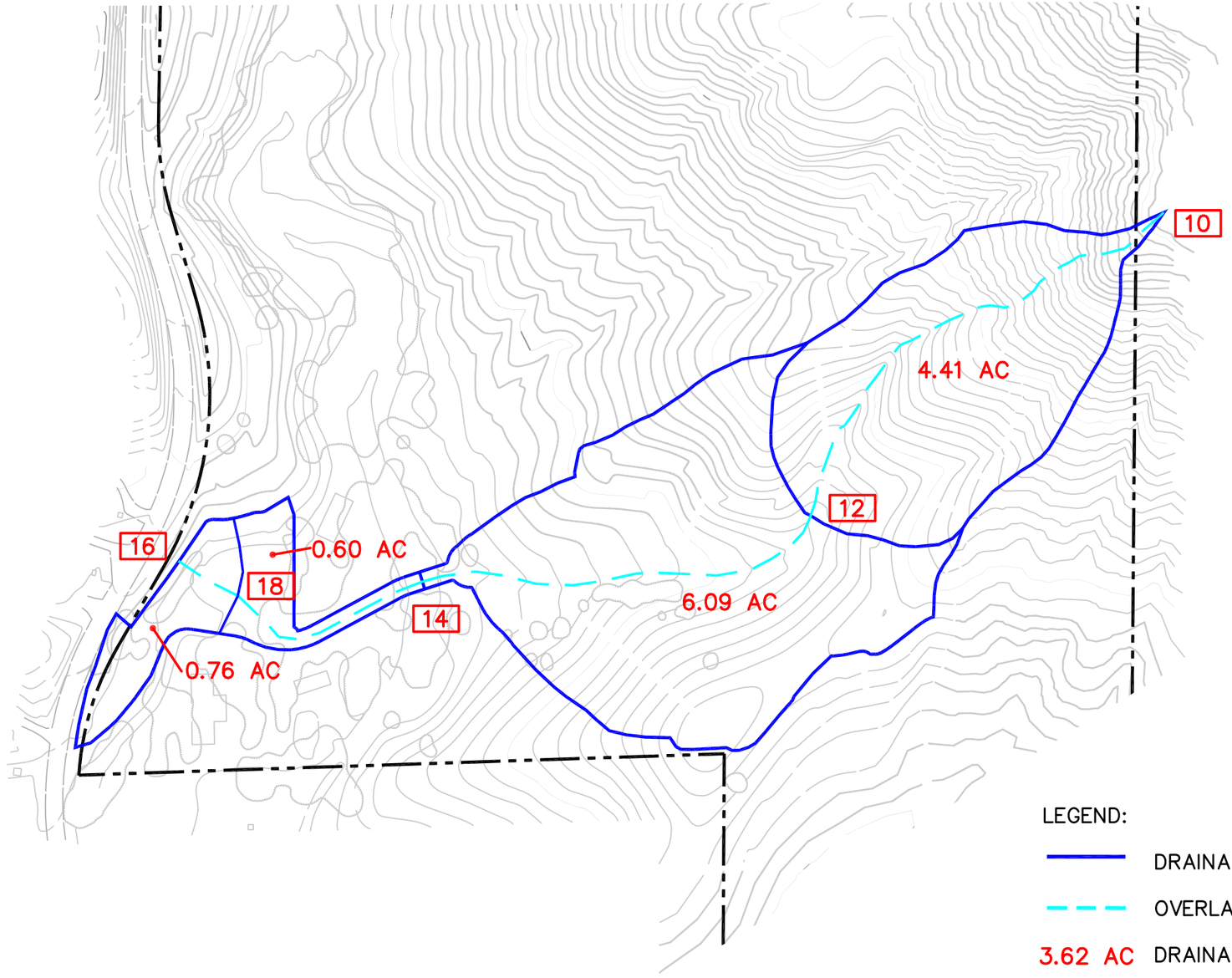
APPENDIX A

100-YEAR HYDROLOGIC ANALYSES



1" = 200'

0 200



LEGEND:

DRAINAGE BASIN BOUNDARY

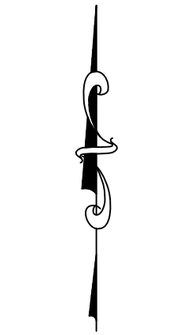
OVERLAND FLOW PATH

3.62 AC DRAINAGE BASIN AREA

10 RATIONAL METHOD NODE NUMBER

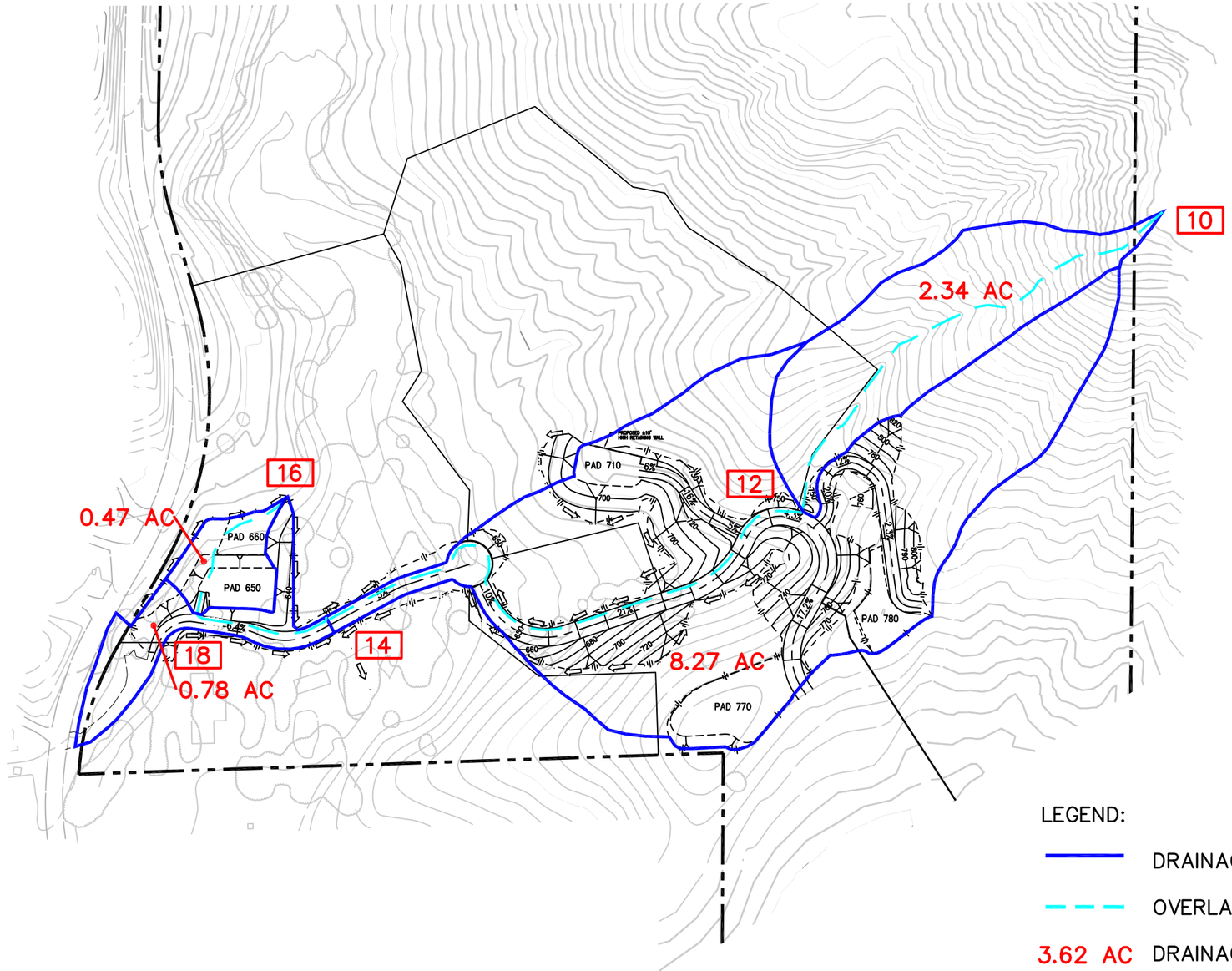
EXISTING CONDITION

RATIONAL METHOD WORK MAP



1" = 200'

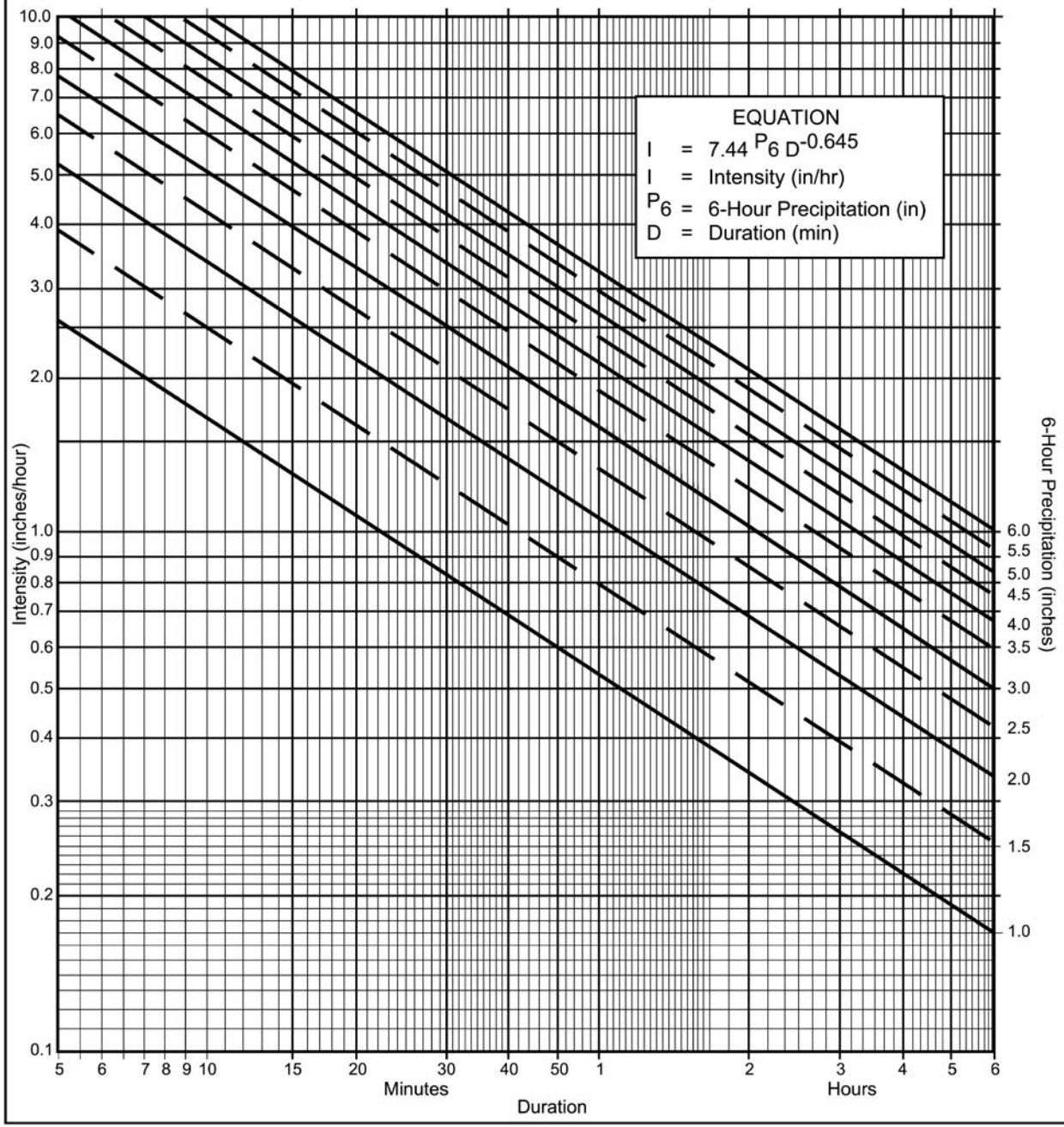
0 200



LEGEND:

- DRAINAGE BASIN BOUNDARY
- OVERLAND FLOW PATH
- 3.62 AC DRAINAGE BASIN AREA
- 10 RATIONAL METHOD NODE NUMBER

PROPOSED CONDITION
RATIONAL METHOD WORK MAP



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.9 in., P_{24} = 6.2, $\frac{P_6}{P_{24}}$ = 47 %(2)

(c) Adjusted P_6(2) = 2.9 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE 3-1

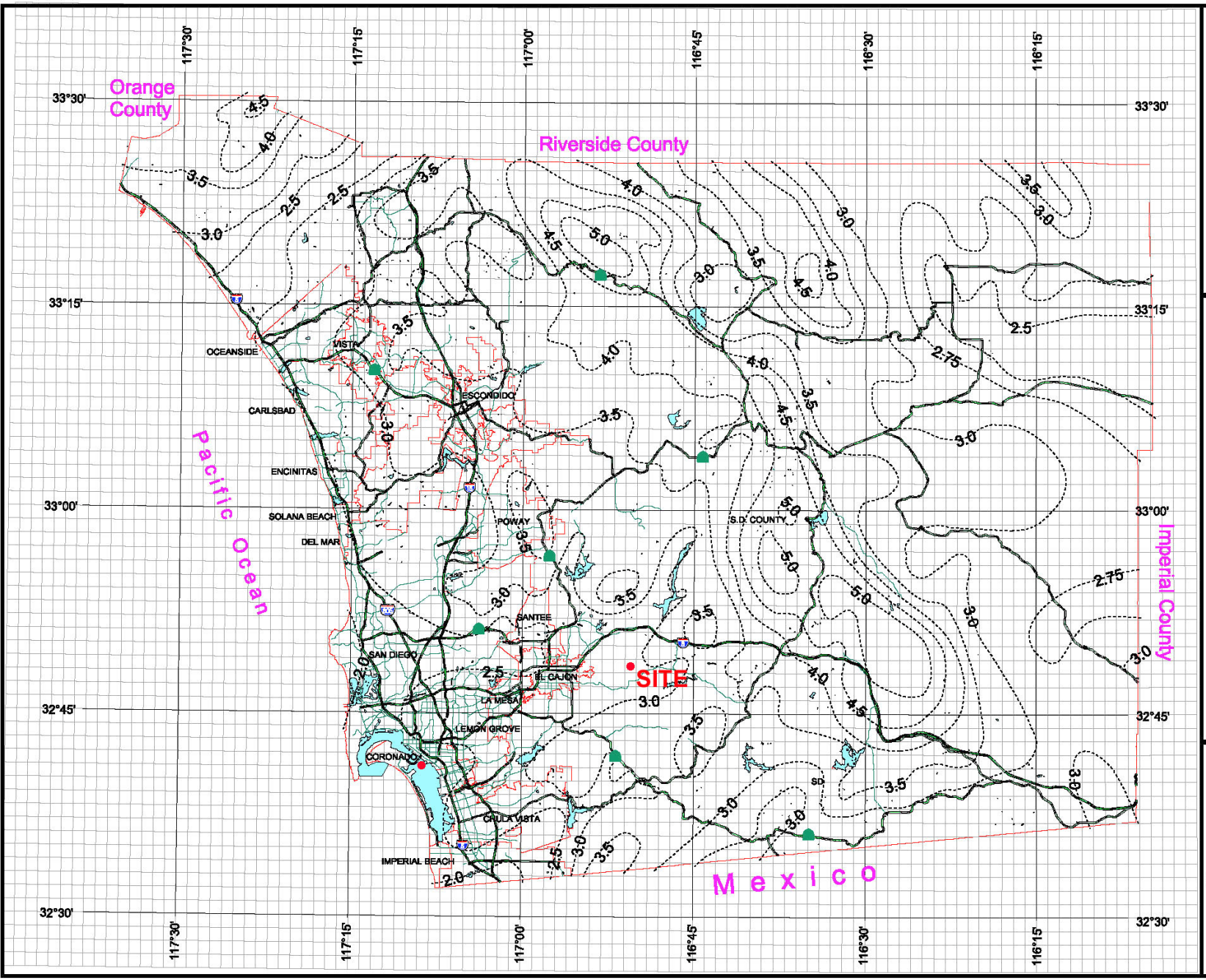
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

P6 = 2.9”

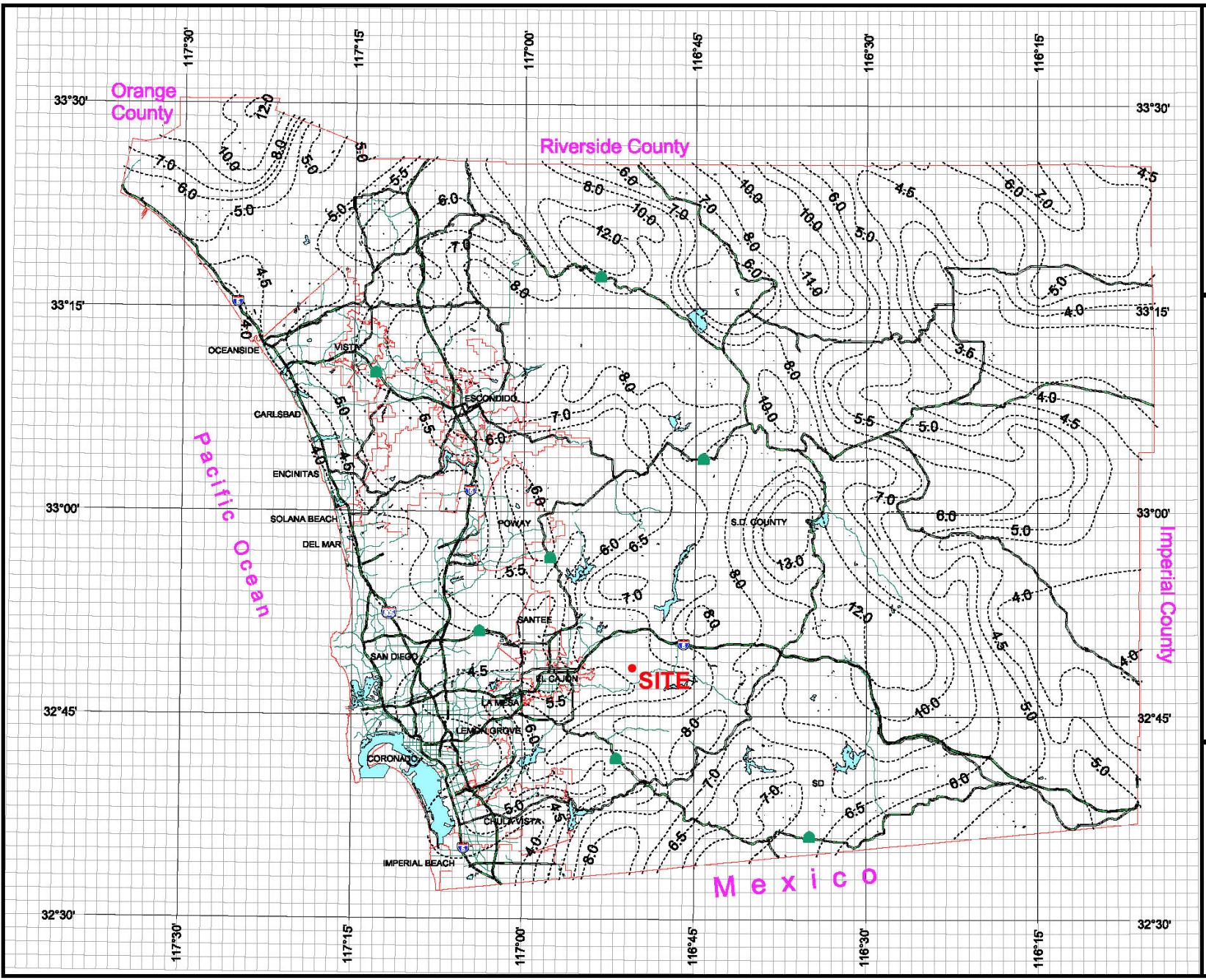


DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

P24 = 6.2"

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
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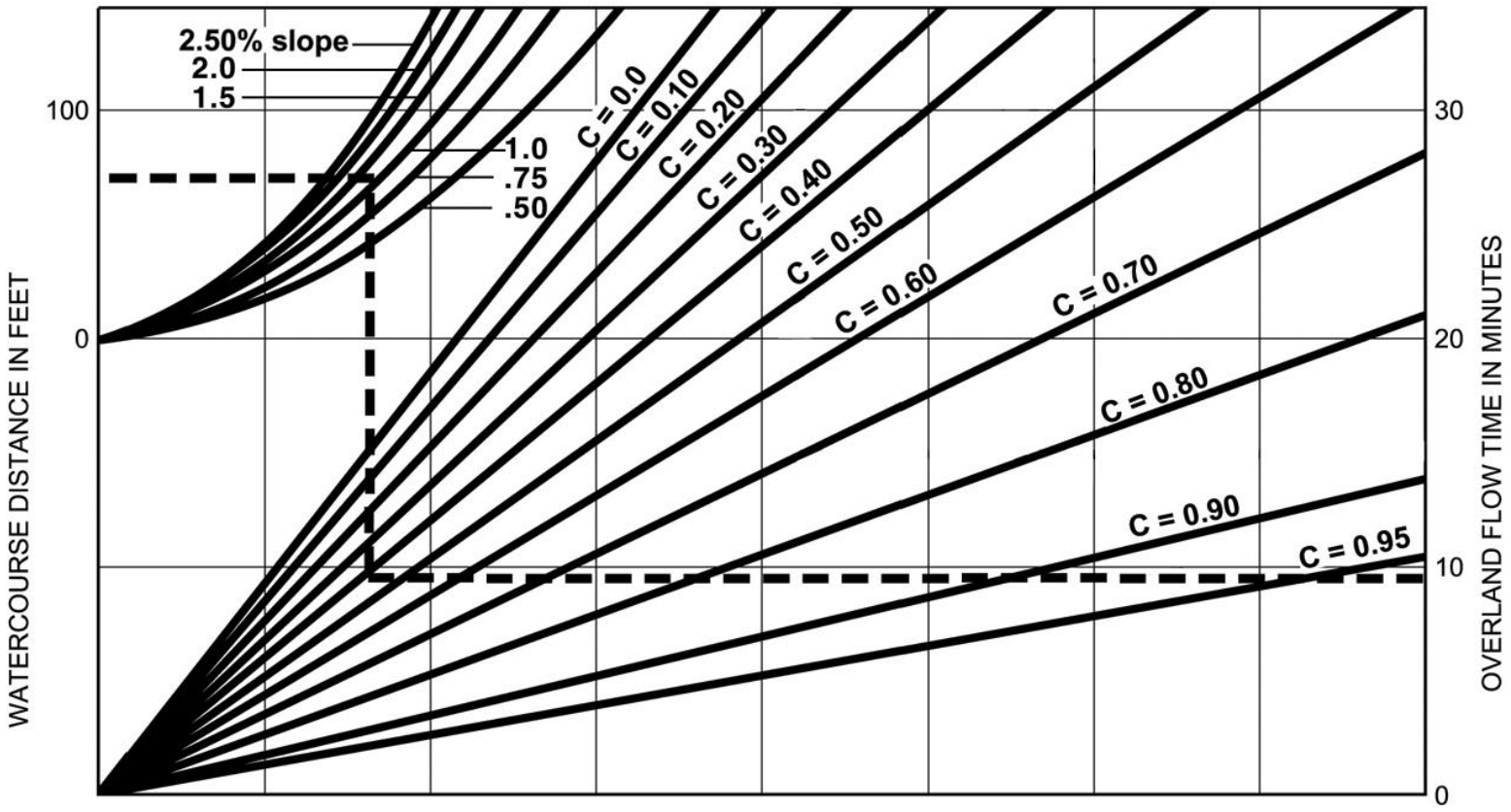
3 0 3 Miles



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE 3-3

Rational Formula - Overland Time of Flow Nomograph

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service


116° 50' 47"
116° 50' 13"
514380
514470
514560
514650
514740
514830
514920
515010
515100
515190
32° 48' 29"
32° 48' 10"
3630030
3629940
3629850
3629760
3629670
3629580
3629490
CmrG
Soil Type B
VsG
Public Rd
VaA
Soil Type B
VsG
Soil Type B
Public Rd
Harbison Canyon Rd
Stream
VsG
Map Scale: 1:4,160 if printed on A size (8.5" x 11") sheet.
N
Meters
0
50
100
200
300
Feet
0
200
400
800
1,200

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:4,160 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 6, Dec 17, 2007

Date(s) aerial images were photographed: 5/31/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

San Diego County Area, California (CA638)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes	21.1	28.6%
VaA	Visalia sandy loam, 0 to 2 percent slopes	13.8	18.7%
VsG	Vista coarse sandy loam, 30 to 65 percent slopes	38.9	52.7%
Totals for Area of Interest		**73.9**	**100.0%**

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2006 Version 7.7

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
      Rational Hydrology Study   Date: 03/18/09

TPM 21008
PRELIMINARY HYDROLOGY
EXISTING CONDITIONS
100-YEAR STORM EVENT

 *********   Hydrology Study Control Information **********

Program License Serial Number 4028

Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 2.900
24 hour precipitation(inches) = 6.200
P6/P24 =   46.8%
San Diego hydrology manual 'C' values used

++
Process from Point/Station   10.000 to Point/Station   12.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN   ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.250
Initial subarea total flow distance = 792.000(Ft.)
Highest elevation = 1120.000(Ft.)
Lowest elevation = 735.000(Ft.)
Elevation difference = 385.000(Ft.) Slope = 48.611 %
Top of Initial Area Slope adjusted by User to 30.000 %
Bottom of Initial Area Slope adjusted by User to 30.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 30.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.92 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]

```
TC = [1.8*(1.1-0.2500)*( 100.000^.5)/(  30.000^(1/3)]=   4.92
The initial area total distance of  792.00 (Ft.) entered leaves a
remaining distance of  692.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   1.91 minutes
for a distance of 692.00 (Ft.) and a slope of 30.00 %
with an elevation difference of 207.60(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    1.909 Minutes
Tt=[(11.9*0.1311^3)/(207.60)]^.385=  1.91
Total initial area Ti =   4.92 minutes from Figure 3-3 formula plus
  1.91 minutes from the Figure 3-4 formula =   6.83 minutes
Rainfall intensity (I) =      6.247(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.250
Subarea runoff =      6.887(CFS)
Total initial stream area =        4.410(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
________________________________________________________________________
Upstream point elevation =   735.000(Ft.)
Downstream point elevation =   625.000(Ft.)
Channel length thru subarea  =   657.000(Ft.)
Channel base width      =    3.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     10.620(CFS)
Manning's 'N'    = 0.040
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     10.620(CFS)
Depth of flow =   0.382(Ft.), Average velocity =   6.700(Ft/s)
Channel flow top width =    5.294(Ft.)
Flow Velocity =    6.70(Ft/s)
Travel time  =    1.63 min.
Time of concentration =    8.47 min.
Critical depth =      0.594(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.440(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.250
Rainfall intensity =      5.440(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.250  CA =      2.625
Subarea runoff =      7.392(CFS) for      6.090(Ac.)
Total runoff =     14.279(CFS)      Total area =      10.500(Ac.)
Depth of flow =   0.449(Ft.), Average velocity =   7.319(Ft/s)
Critical depth =      0.703(Ft.)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Process from Point/Station       12.000 to Point/Station       14.000
**** CONFLUENCE OF MAIN STREAMS ****
--------------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     10.500(Ac.)
Runoff from this stream =     14.279(CFS)
Time of concentration =    8.47 min.
Rainfall intensity =     5.440(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       18.000
**** INITIAL AREA EVALUATION ****
--------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.250
Initial subarea total flow distance  =  108.000(Ft.)
Highest elevation =  660.000(Ft.)
Lowest elevation =  638.000(Ft.)
Elevation difference =   22.000(Ft.) Slope = 20.370 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  20.37 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.60 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.2500)*( 100.000^.5)/(  20.370^(1/3)]=   5.60
The initial area total distance of  108.00 (Ft.) entered leaves a
remaining distance of    8.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   0.07 minutes
for a distance of   8.00 (Ft.) and a slope of 20.37 %
with an elevation difference of   1.63(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    0.071 Minutes
Tt=[(11.9*0.0015^3)/(  1.63)]^.385=  0.07
Total initial area Ti =   5.60 minutes from Figure 3-3 formula plus
  0.07 minutes from the Figure 3-4 formula =   5.67 minutes
Rainfall intensity (I) =      7.043(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.250
Subarea runoff =      1.338(CFS)
Total initial stream area =        0.760(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
--------------------------------------------------------------------------------
Upstream point elevation =   638.000(Ft.)
```

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Downstream point elevation =   625.000(Ft.)
Channel length thru subarea  =   340.000(Ft.)
Channel base width      =   12.000(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      1.769(CFS)
Manning's 'N'    = 0.020
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      1.769(CFS)
Depth of flow =   0.064(Ft.), Average velocity =   2.295(Ft/s)
Channel flow top width =   12.254(Ft.)
Flow Velocity =    2.29(Ft/s)
Travel time  =    2.47 min.
Time of concentration =    8.14 min.
Critical depth =      0.087(Ft.)
 Adding area flow to channel
Rainfall intensity (I) =      5.578(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.320
Rainfall intensity =      5.578(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.281  CA =      0.382
Subarea runoff =      0.793(CFS) for      0.600(Ac.)
Total runoff =      2.131(CFS)      Total area =       1.360(Ac.)
Depth of flow =   0.071(Ft.), Average velocity =   2.469(Ft/s)
Critical depth =      0.099(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       14.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      1.360(Ac.)
Runoff from this stream =      2.131(CFS)
Time of concentration =    8.14 min.
Rainfall intensity =     5.578(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       14.279      8.47               5.440
2        2.131      8.14               5.578
Qmax(1) =
         1.000 *    1.000 *    14.279) +
         0.975 *    1.000 *     2.131) + =      16.357
Qmax(2) =
         1.000 *    0.962 *    14.279) +
```

```
         1.000 *    1.000 *     2.131) + =      15.864

Total of 2 main streams to confluence:
Flow rates before confluence point:
      14.279       2.131
Maximum flow rates at confluence using above data:
       16.357       15.864
Area of streams before confluence:
       10.500        1.360


Results of confluence:
Total flow rate =     16.357(CFS)
Time of concentration =     8.467 min.
Effective stream area after confluence  =     11.860(Ac.)
End of computations, total study area =          11.860 (Ac.)
```

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2006 Version 7.7

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
      Rational Hydrology Study   Date: 03/18/09

TPM 21008
PRELIMINARY HYDROLOGY
PROPOSED CONDITIONS
100-YEAR STORM EVENT

 *********   Hydrology Study Control Information **********

Program License Serial Number 4028

Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 2.900
24 hour precipitation(inches) = 6.200
P6/P24 =   46.8%
San Diego hydrology manual 'C' values used

++
Process from Point/Station   10.000 to Point/Station   12.000
**** INITIAL AREA EVALUATION ****
_____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[UNDISTURBED NATURAL TERRAIN   ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.250
Initial subarea total flow distance = 797.000(Ft.)
Highest elevation = 1120.000(Ft.)
Lowest elevation = 742.000(Ft.)
Elevation difference = 378.000(Ft.) Slope = 47.428 %
Top of Initial Area Slope adjusted by User to 30.000 %
Bottom of Initial Area Slope adjusted by User to 30.000 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 30.00 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.92 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]

```
TC = [1.8*(1.1-0.2500)*( 100.000^.5)/(  30.000^(1/3)]=   4.92
The initial area total distance of  797.00 (Ft.) entered leaves a
remaining distance of  697.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   1.92 minutes
for a distance of 697.00 (Ft.) and a slope of 30.00 %
with an elevation difference of 209.10(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    1.920 Minutes
Tt=[(11.9*0.1320^3)/(209.10)]^.385=  1.92
Total initial area Ti =   4.92 minutes from Figure 3-3 formula plus
  1.92 minutes from the Figure 3-4 formula =   6.84 minutes
Rainfall intensity (I) =      6.240(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.250
Subarea runoff =      3.651(CFS)
Total initial stream area =        2.340(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       14.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =   742.000(Ft.)
End of street segment elevation =   630.000(Ft.)
Length of street segment  =   937.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  14.000(Ft.)
Distance from crown to crossfall grade break  =  12.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   6.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  1.500(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0180
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =     10.210(CFS)
Depth of flow =   0.329(Ft.), Average velocity =   7.096(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  11.695(Ft.)
Flow velocity =   7.10(Ft/s)
Travel time =    2.20 min.     TC =    9.04  min.
 Adding area flow to street
Rainfall intensity (I) =      5.213(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.320
Rainfall intensity =      5.213(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.305  CA =      3.231
Subarea runoff =     13.195(CFS) for      8.270(Ac.)
```

```
Total runoff =     16.846(CFS)      Total area =      10.610(Ac.)
Street flow at end of street =     16.846(CFS)
Half street flow at end of street =     16.846(CFS)
Depth of flow =   0.379(Ft.), Average velocity =   8.054(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  14.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       14.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     10.610(Ac.)
Runoff from this stream =     16.846(CFS)
Time of concentration =    9.04 min.
Rainfall intensity =     5.213(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       18.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.320
Initial subarea total flow distance  =  243.000(Ft.)
Highest elevation =  660.000(Ft.)
Lowest elevation =  644.000(Ft.)
Elevation difference =   16.000(Ft.) Slope =  6.584 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   6.58 %, in a development type of
 1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   7.49 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3200)*( 100.000^.5)/(   6.584^(1/3)]=   7.49
The initial area total distance of  243.00 (Ft.) entered leaves a
remaining distance of  143.00 (Ft.)
Using Figure 3-4, the travel time for this distance is   1.02 minutes
for a distance of 143.00 (Ft.) and a slope of  6.58 %
with an elevation difference of   9.42(Ft.) from the end of the top area
Tt = [11.9*length(Mi)^3)/(elevation change(Ft.))]^.385 *60(min/hr)
 =    1.016 Minutes
Tt=[(11.9*0.0271^3)/(  9.42)]^.385=  1.02
Total initial area Ti =   7.49 minutes from Figure 3-3 formula plus
  1.02 minutes from the Figure 3-4 formula =   8.51 minutes
Rainfall intensity (I) =      5.423(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.320
```

```
Subarea runoff =      0.816(CFS)
Total initial stream area =        0.470(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       14.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
_____________________________________________________________________________
Top of street segment elevation =   644.000(Ft.)
End of street segment elevation =   630.000(Ft.)
Length of street segment  =   222.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  14.000(Ft.)
Distance from crown to crossfall grade break  =  12.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   6.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  1.500(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0180
 Manning's N from grade break to crown =  0.0180
Estimated mean flow rate at midpoint of street =      1.454(CFS)
Depth of flow =   0.210(Ft.), Average velocity =   3.598(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   5.769(Ft.)
Flow velocity =   3.60(Ft/s)
Travel time =    1.03 min.     TC =    9.54  min.
 Adding area flow to street
Rainfall intensity (I) =      5.038(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                     ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.320
Rainfall intensity =      5.038(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.320  CA =      0.400
Subarea runoff =      1.200(CFS) for      0.780(Ac.)
Total runoff =      2.015(CFS)      Total area =       1.250(Ac.)
Street flow at end of street =      2.015(CFS)
Half street flow at end of street =      2.015(CFS)
Depth of flow =   0.230(Ft.), Average velocity =   3.844(Ft/s)
Flow width (from curb towards crown)=   6.730(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       14.000
**** CONFLUENCE OF MAIN STREAMS ****
_____________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
```

```
Stream flow area =      1.250(Ac.)
Runoff from this stream =      2.015(CFS)
Time of concentration =    9.54 min.
Rainfall intensity =     5.038(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                (In/Hr)

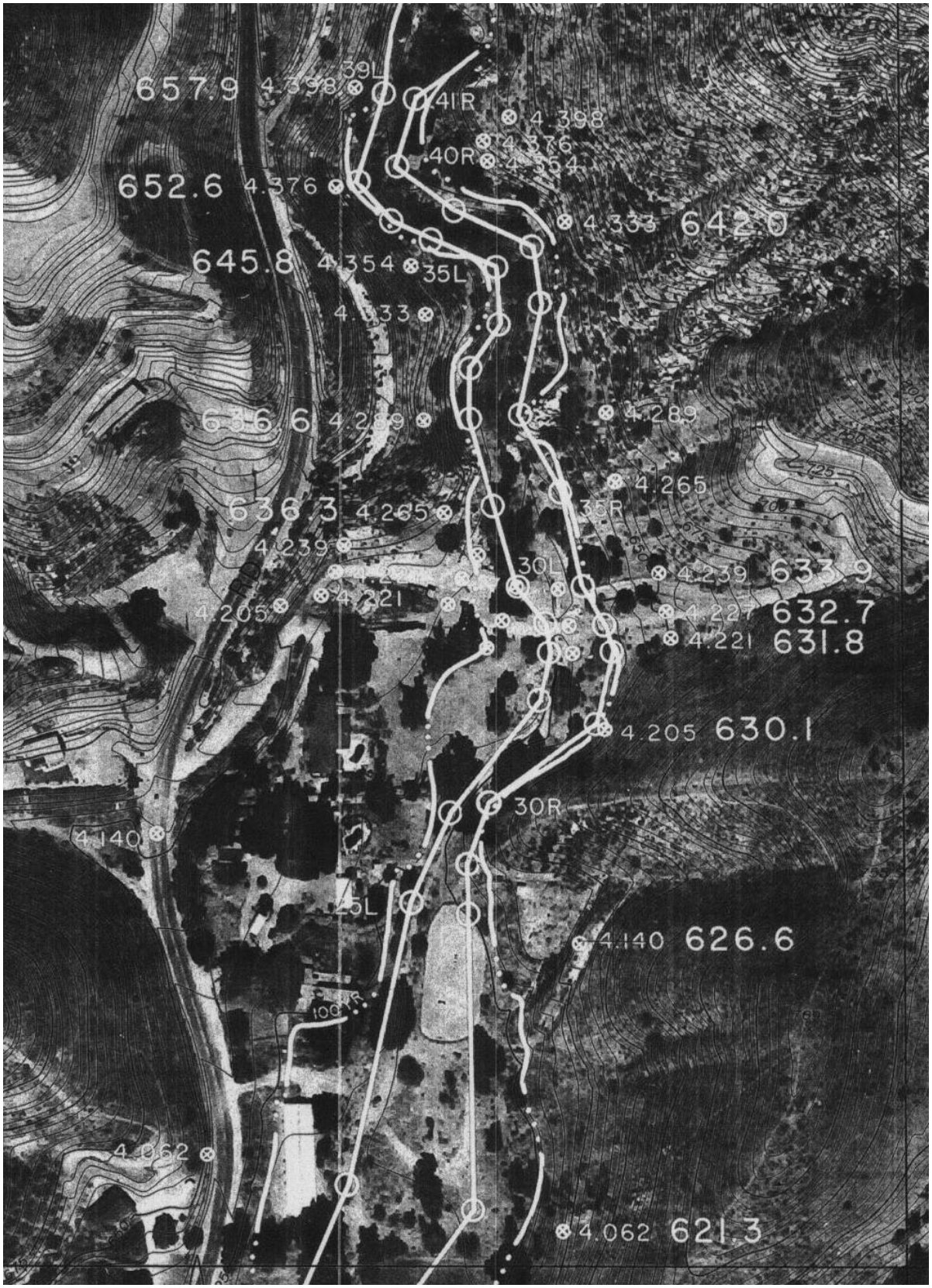

1       16.846      9.04               5.213
2        2.015      9.54               5.038
Qmax(1) =
         1.000 *    1.000 *    16.846) +
         1.000 *    0.948 *     2.015) + =      18.758
Qmax(2) =
         0.966 *    1.000 *    16.846) +
         1.000 *    1.000 *     2.015) + =      18.296

Total of 2 main streams to confluence:
Flow rates before confluence point:
      16.846       2.015
Maximum flow rates at confluence using above data:
       18.758       18.296
Area of streams before confluence:
       10.610        1.250


Results of confluence:
Total flow rate =     18.758(CFS)
Time of concentration =     9.044 min.
Effective stream area after confluence  =     11.860(Ac.)
End of computations, total study area =          11.860 (Ac.)
```

APPENDIX B

HYDRAULIC ANALYSES



COUNTY OF SAN DIEGO FLOODPLAIN MAP

HEC-2 RESULTS

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	3.982	221.00	.00	.00	608.90	3900.00	616.51	616.51	617.78	66.21	9.83	495.81	479.31
	3.982	221.00	.00	.00	608.90	3900.00	616.28	616.28	618.49	107.08	12.14	335.89	376.88
*	3.982	221.00	.00	.00	608.90	850.00	612.82	.00	613.82	126.50	8.05	105.56	75.57
*	4.062	433.00	.00	.00	615.40	3900.00	620.70	620.70	621.54	78.11	9.26	614.80	441.28
	4.062	433.00	.00	.00	615.40	3900.00	621.32	.00	622.30	69.55	9.42	546.27	467.65
*	4.062	433.00	.00	.00	615.40	850.00	618.67	618.67	619.53	94.88	7.54	124.28	87.27
*	4.140	417.00	.00	.00	620.40	3900.00	626.52	626.52	627.94	69.86	10.92	473.86	466.60
*	4.140	417.00	.00	.00	620.40	3900.00	626.62	626.62	628.78	91.69	12.66	359.68	407.28
	4.140	417.00	.00	.00	620.40	850.00	623.21	623.17	624.33	137.29	8.48	100.18	72.54
*	4.205	323.00	.00	.00	623.20	3900.00	630.05	630.05	632.16	127.47	11.67	334.15	345.43
	4.205	323.00	.00	.00	623.20	3900.00	630.13	630.10	632.16	119.71	11.43	341.14	356.45
	4.205	323.00	.00	.00	623.20	850.00	627.46	.00	628.07	96.26	6.23	136.46	86.63
*	4.221	79.00	.00	.00	624.40	3900.00	631.77	631.77	633.16	85.37	9.80	451.25	422.09
*	4.221	79.00	.00	.00	624.40	3900.00	631.48	631.48	633.51	124.71	11.46	340.43	349.23
*	4.221	79.00	.00	.00	624.40	850.00	628.50	628.50	629.34	149.87	7.34	115.82	69.43
*	4.227	39.00	.00	.00	624.70	3900.00	632.66	632.66	634.14	76.23	10.12	443.84	446.67
*	4.227	39.00	.00	.00	624.70	3900.00	632.24	632.24	634.48	118.61	12.02	324.40	358.10
	4.227	39.00	.00	.00	624.70	850.00	628.98	.00	629.84	108.92	7.46	113.92	81.44
*	4.239	55.00	.00	.00	625.50	3900.00	633.73	633.73	635.13	62.11	10.59	503.48	494.86
*	4.239	55.00	.00	.00	625.50	3900.00	633.88	633.88	635.92	82.54	11.99	371.61	429.27
	4.239	55.00	.00	.00	625.50	850.00	629.37	.00	630.58	122.72	8.85	96.08	76.73
	4.265	138.00	.00	.00	626.60	3700.00	635.41	.00	635.89	39.89	5.93	673.46	585.84
*	4.265	138.00	.00	.00	626.60	3700.00	636.29	.00	636.79	35.17	5.78	658.26	623.90
	4.265	138.00	.00	.00	626.60	800.00	631.59	.00	631.87	63.06	4.22	189.64	100.74
*	4.289	134.00	.00	.00	628.10	3700.00	635.66	.00	637.10	145.70	9.67	388.42	306.53
*	4.289	134.00	.00	.00	628.10	3700.00	636.62	.00	637.69	94.63	8.30	445.69	380.35
	4.289	134.00	.00	.00	628.10	800.00	632.54	.00	632.93	95.59	5.00	160.02	81.83
*	4.333	235.00	.00	.00	635.80	3700.00	642.00	642.00	643.71	214.82	10.89	363.11	252.44
*	4.333	235.00	.00	.00	635.80	3700.00	642.04	642.04	644.40	301.54	12.34	299.79	213.07
*	4.333	235.00	.00	.00	635.80	800.00	638.95	638.95	639.89	371.56	7.78	102.82	41.50
*	4.354	114.00	.00	.00	638.90	3700.00	645.84	645.84	647.71	185.80	11.42	350.57	271.44
*	4.354	114.00	.00	.00	638.90	3700.00	645.71	645.71	648.46	301.26	13.31	277.99	213.17
	4.354	114.00	.00	.00	638.90	800.00	642.47	.00	643.26	238.77	7.14	112.08	51.77
*	4.376	117.00	.00	.00	645.70	3700.00	652.59	652.59	654.32	192.82	10.95	368.23	266.46
*	4.376	117.00	.00	.00	645.70	3700.00	652.40	652.40	654.89	284.49	12.68	291.76	219.37
*	4.376	117.00	.00	.00	645.70	800.00	648.57	648.57	649.71	351.98	8.60	93.06	42.64

Culvert Calculator Report
Access Road Culverts

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	0.00	ft	Headwater Depth/Height	2.12	
Computed Headwater Elevation	633.98	ft	Discharge	850.00	cfs
Inlet Control HW Elev.	633.80	ft	Tailwater Elevation	629.00	ft
Outlet Control HW Elev.	633.98	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	625.50	ft	Downstream Invert	624.70	ft
Length	55.00	ft	Constructed Slope	0.000000	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	4.30	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	3.73	ft
Velocity Downstream	13.53	ft/s	Critical Slope	0.012113	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	4.00	ft
Section Size	48 inch		Rise	4.00	ft
Number Sections	5				

Outlet Control Properties					
Outlet Control HW Elev.	633.98	ft	Upstream Velocity Head	2.84	ft
Ke	0.20		Entrance Loss	0.57	ft

Inlet Control Properties					
Inlet Control HW Elev.	633.80	ft	Flow Control	Submerged	
Inlet Type	Groove end w/headwall		Area Full	62.8	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				